IN THE UNITED STATES PATENT AND TRADE MARK OFFICE

VERIFICATION OF TRANSLATION

I, Michael Wallace Richard Turner, Bachelor of Arts, Chartered Patent Attorney, European Patent Attorney, of 1 Horsefair Mews, Romsey, Hampshire SO51 8JG, England, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof;

I verify that the attached English translation is a true and correct translation made by me of the attached Amended Pages in the German language of International Application PCT/EP2004/002822;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Microstructure and process for the production of microstructures

The invention relates to a process for the production of microstructures which are formed by the superimposition of a relief structure with at least one second relief structure.

Light-diffracting microstructures have a plurality of recesses which are generally in the form of parallel grooves and which for example form an optical grating with a microscopically fine relief structure. Light which is incident on the microstructures is diffracted or scattered in a manner which is predetermined by the microstructure. Mosaics consisting of the microstructures are shaped for example in plastic material or metal and serve as authenticity features for valuable articles. Those authenticity features exhibit a striking optical behaviour and are difficult to imitate.

Some processes are known for the production of microstructures of that kind. Thus mechanical apparatuses produce the microstructures by scratching many parallel grooves in a substrate surface. The shape of the scratching tool determines the profile of the relief structure. The operation of scratching the relief structure becomes progressively more difficult and consequently expensive, with an increasing number of lines per millimeter. Holographic processes are less expensive, wherein two coherent light beams from a laser light source are caused to interfere on a photosensitive layer of photoresist. The interference image with its light and dark fringes expose the photoresist in accordance with the local level of light intensity. After development the surface of the photoresist has a relief structure of a symmetrical profile. In a further process an electron beam draws the relief structure groove by groove in the layer of photoresist, in which case the grooves can also form curved lines. The microstructure master shapes produced in accordance with those processes can be replicated galvanically and with the copies produce metallic stamping punches with which the

shape of the microstructures can be produced in metal or plastic material. With those processes however the apparatus expenditure for the production of microstructures is extremely high.

It is also known from EP-A 0 105 099 for new microstructures to be synthesised in the form of a mosaic, in which case one out of a set of different relief structures, oriented in a predetermined manner in the azimuth, is mechanically shaped in each surface element of the mosaic.

US No 5 138 604 discloses a recording means whose first macroscopic relief structure is superimposed with a second diffractive structure. The first relief structure is registered by means of exposure through a mask in an unexposed photoresist layer. The exposed photoresist layer is then exposed again, in which case the interference pattern of a hologram acts on the photoresist layer. After development of the photoresist layer, the first relief structure corresponding to the mask structure remains on the substrate of the photoresist layer, the backs of the first relief structure having the diffractive structure of the hologram.

WO 00/61386 describes the production of a decorative film. Macroscopic structures are shaped into the surface of a film by means of a stamping punch. If, instead of smooth punch surfaces, such punch surfaces which are provided with a microscopically fine structure are used for the shaping operation, the macroscopic structures shaped into the film have the microscopically fine structures.

A method is described in JP 2000 264000 for the production of a diffractive structure which is superimposed with an additional structure. That method uses the change in length of a resin which hardens by radiation, if it is heated greatly during the hardening process. A diffractive relief is firstly shaped into the semi-hardened layer of the resin and a reflection layer is applied to the surface which is deformed with the relief. Due to heating of the resin, the change in length causes additional deformation of the surface in the form of wrinkles. Those wrinkles are also superimposed on the relief. Further hardening of the resin fixes the relief with the superimposed wrinkle structure.

US No 4 537 504 discloses a diffractive structure which is shaped on a corrugated surface, the period of the corrugations of the surface being much greater than the period of the diffractive structure.

US No 6 043 936 describes two methods of producing the casting mold for shaping diffractive step pyramids. A first method is the above-described, purely mechanical removal method and the second method uses an anisotropic etching method in silicon for producing the pyramid shape. The smooth pyramid surfaces then receive a coating of photoresist. The photoresist layer is exposed under the action of an electron beam in such a way that, after development of the photoresist layer, the pyramid surfaces have steps. The shapes of the diffractive step pyramids are produced galvanically, for the production of punch dies.

The subject-matter of WO 03/084764 concerns a security element which is difficult to copy, enclosed in a layer composite. The diffractive structures of the security element are additively superimposed with a macroscopic superimposition function, wherein the superimposition functions change slowly in comparison with the diffractive structures.

The object of the invention is to propose an inexpensive process for the production of a microstructure whose relief structure is produced by a superimposition of at least two relief structures, so that a microstructure, for example for a replication master, which is relatively easy to produce with a high degree of accuracy and which is complicated and consequently difficult to imitate is formed.

According to the invention the specified object is attained by the features recited in claim 1 and is based on the idea of combining a stamping or other mechanical shaping process with a photostructuring in order to produce microstructures which are inexpensive but nonetheless complicated. Advantageous configurations of the invention are set forth in the further claims.

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